REDACTED VERSION

September 22, 1998

(b) (6) [redacted]

DRAFT

Re: Westbank Asbestos Removal Project

Dear Ms. :

As you are aware, IT Corporation (IT), through a contract with the U.S. Army Corp of Engineers (USACE), performed the asbestos removal work on your property at (b) (6) [redacted] during the period of June 23, 1997 through July 16, 1997. You have claimed that as a result of this work, damage to your home has occurred.

Through a review of the documentation of the activities at the site, including viewing the video tape of the work as it progressed, and supported by the building inspection which was performed by Gilbert Engineering, the U.S. Environmental Protection Agency (USEPA) does not feel that the damage was a direct result of the asbestos removal activities. The reasons for this are as follows:

1. The excavation at your property was approximately 12" deep in the driveway area which is not a significant depth to cause settlement to the foundation of the house. This was the standard depth of construction for most of the properties addressed during this project and no other homes experienced any settlement due the removal activities.

2. The excavation which was performed under your house, which you insisted be performed, was approximately 6" deep and extended under the house for approximately 2 feet. This excavation was performed with hand shovels, and would also not cause the foundation to settle.

3. Based on the report prepared by Gilbert Engineering and Inspection Services, who inspected the property damage on August 4, 1998, there was no structural damage to the building observed. According to the report, the building showed signs of differential settlement throughout the house which is actually less than the average measured during routine structural inspections performed in the Greater New Orleans area. It is difficult to determine if the construction activities added to or caused the differential settlement of the house.

4. The cosmetic damage to the sheetrock inside your home is also most likely due to the differential settlement of the house, according to the Inspection report. Again, without additional testing, such as soil or vibration testing, it is difficult to determine the exact reason for the settlement and subsequent cracking of the sheetrock.

90055141

Please be aware that we are not attempting to avoid thc responsibility of corrccting any damage that was done by our contractor performing the removal activities, however, it is felt that other factors have led to the damage to your home.

Please contact me at your earliest convenience to furthcr discuss this matter in order to bring a mutually agrccable resolution.

Sincerely,
USEPA

DRAFT

John Martin
On-scene Coordinator

cc: D. White, USACE
J. Hobza, USACE
T. Mathison, IT Corp.

INTERNATIONAL TECHNOLOGY CORPORATION

IT Corporation
2790 Mosside Blvd.
Monroeville, PA. 15146

Transmission Confirmation # (412) 372-7701, Ext. 2900

DATE: 9/24/98

Number of Pages (w/ cover) 3

TO: JOHN MARTIN

USEPA

(214) 665-7447

From: Tom Mathison
(412) 858-3303
(412) 374-1486 Fax

Comments: JOHN, PER DENZIE & YOUR REQUEST, HERE IS A DRAFT LETTER REGARDING 609 BROWN AVE. PLEASE EDIT AS YOU SEE FIT. ANY QUESTIONS, PLEASE CALL!

TOM

U.S. Department of Justice

Eastern District of Louisiana
U. S. Attorney's Office

Eileen Gleason
Assistant United States Attorney

Hale Boggs Federal Building
501 Magazine Street, Second Floor
New Orleans, LA 70130

Telephone # :(504) 680-3118
Fax # : (504) 589-4510

RECEIVED
JUN 04 1999
6RC-S SUPERFUND
REGIONAL COUNSEL

May 24, 1999

Keith Smith, Esq.
Mail Code 6RC-S
U.S. Environmental Protection Agency
1445 Ross Avenue, Suite 1200
Dallas, TX 75202

Dear Mr. Smith:

Pursuant to your conversation with Eileen Gleason today, enclosed please find a copy of a letter from (b) (6) [redacted].

Very truly yours,

EDDIE J. JORDAN, JR.
UNITED STATES ATTORNEY

Sharon C. Johnson

Sharon C. Johnson
Paralegal Assistant
for Eileen Gleason

scj
enclosure

May 13, 1999

[redacted]

U. S. Attorney's Office
501 Magazine Street
2nd Floor
New Orleans, LA 70130

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
#P 215 229 682

Dear Sir/Madam:

Please find enclosed a copy of our letter, dated March 24, 1999, to J. Dale Givens of the Department of Environmental Quality, State of Louisiana.

Also enclosed is a copy of the letter we received from Mr. Givens, dated May 5, 1999, which states that our concerns "...must be addressed by EPA and its contractors".

It is our understanding that you are the proper agent to address these concerns.

Accordingly, we are once again attempting to amicably settle this matter by bringing the concerns in our letter of March 24th to your attention. It is still our hope to reach a resolution without the necessity of litigation.

Sincerely,

[redacted]

Enclosures

March 24, 1999

(b) (6) [redacted]

Dale Givens, Secretary
Head of the Department
of Environmental Quality
7290 Bluebonnet Road
Baton Rouge, Louisiana 70810

CERTIFIED MAIL
RETURN RECEIPT REQUESTED
#P 215 229 680

Dear Mr. Givens:

In 1997 our property was one of those on which asbestos removal took place, pursuant to "EPA's response responsibilities under the Comprehensive Environmental Response, Compensation, and Liability Act, as amended (CERCLA), 42 U.S.C. § 9601 et seq".

After this action, our home began to show structural damage that had never been seen before in its nearly thirty year history. Being at a loss as to what was happening, we consulted a Registered Professional Engineer in Mechanical Engineering. In his words, "...it is apparent that the recent contractor's work de-stabilized your foundation system and caused it to begin sinking, which in turn is causing the break up of your building's materials. Since this is obviously an active situation, it will continue to worsen and cause even more damages...".

On several occasions, and at great length, we have discussed this situation with the EPA's "outreach office", that was located behind the State Building at 2150 Westbank Expressway, Harvey, Louisiana. However, the representatives there failed to take any responsibility, insisting that it was a natural occurrence and not their fault.

Considering the well-structured house we live in, one that was built by and always owned by our family, we disagree. To the best of our knowledge, our neighbors' homes, subject to the same "natural" changes in the environment as ours, are not experiencing this damage.

It is still our hope that this can be amicably settled. We would prefer to meet with you and work this out, rather than hire an attorney to represent us in litigation.

Thanking you for your attention to this matter, we remain,

Sincerely,

(b) (6) [redacted]

State of Louisiana

Department of Environmental Quality

M.J. "MIKE" FOSTER, JR.
GOVERNOR

J. DALE GIVENS
SECRETARY

May 5, 1999

[redacted]

Dear [redacted] and [redacted]:

We are in receipt of your letter of March 24, 1999. Please be advised that the Westbank remediation project is the responsibility of EPA. The Louisiana Department of Environmental Quality has no legal responsibility, or liability, for any work performed by either EPA , or its contractors.

The Louisiana Department of Environmental Quality's responsibility is limited to the administration and enforcement of DEQ regulations. All work done by EPA and its contractors was in compliance with LA DEQ regulations. Therefore, any mitigation of damages to your property must be addressed by EPA and its contractors.

Should you have any questions concerning this letter, please contact Mr. William E. Coltrin, Program Manager. He can be reached Monday through Friday, 8:00 A.M. – 4:30 P.M. by calling (225) 765-2554.

Sincerely,

J. Dale Givens

JDG:dsh
cc: William E. Coltrin
JDG #99-046

[redacted]

John Martin (65F-R2)
Environmental Protection Agency
1445 Ross Avenue
Dallas, TX 75202

Dear Mr. Martin:

This is in response to the telephone call I received from you on October 5, 1999.

As you requested, please find enclosed a copy of the "Conclusions" of the "Foundation System Evaluation" received from William A. Springer, Professional Engineer, Building Inspection Services, Inc.

Also, it is my understanding from our conversation, that you will contact me when you are in this area in the beginning of November. At that time, I hope that we can resolve this matter.

[redacted]

Enclosure

CERTIFIED MEMBER 91228

BUILDING INSPECTION SERVICES, INC.

******** LICENSED CONSULTING ENGINEERS *********

504-831-2285
800-259-2474
504-831-1692 FAX

A CERTIFIED ASHI MEMBER COMPANY
GENERAL • STRUCTURAL
RESIDENTIAL • COMMERCIAL

2701 METAIRIE RD
METAIRIE, LA
70001-5446

BISI FILE # 111897BS1970

January 5, 1998

[redacted]

Subject: Foundation System Evaluation at:
[redacted]

Dear Ms. Romaguera:

At your request, I met with you at your subject home on 11-18-97 in order to observe, document and evaluate your foundation system's reported recently sustained movements and differential settlements. You advised that Jefferson Parish authorities had hired a contractor to remove asbestos containing cement materials on your property and in this process they also deeply excavated around your foundation piers. You advised that shortly after this work was completed, you began to experience sudden and progressive cracking and bowing of your home's interior and exterior wall materials, which continues to worsen to this day.

My visual evaluation of these interior and exterior cracks and bulges confirms that differential foundation pier movements and settlements are indeed active and causing these damages. My level survey of the foundation system indicates as much as about two inches of foundation drop exists from the rear down toward the front. Numerous photographs were also taken to document current damage conditions and for future comparisons. The level survey data and photographs will be retained at my office for further reference.

CONCLUSIONS

Based on the above delineated information, it is apparent that the recent contractor's work de-stabilized your foundation system and caused it to begin sinking, which in turn is causing the break up of your building's materials. Since this is obviously an active situation, it will continue to worsen and cause even more damages. Therefore, I highly recommend prompt remedial foundation repairs and re-leveling work by a reputable shoring contractor, which must be accomplished prior to implementation of all the other necessary building material damage repairs. My budgetary repair estimate for these damages is about $15,000 to $20,000. Reputable contractors can provide you with definitive estimates which should be obtained prior to commencement of any repair work.

Please advise if you have any questions regarding this report or desire further actions in this matter.

Yours truly,

BUILDING INSPECTION SERVICES, INC.

STATE OF LOUISIANA
WILLIAM ALVIN SPRINGER
REG. No. 8707
REGISTERED
PROFESSIONAL ENGINEER
IN
MECHANICAL ENGINEERING

WA Springer, P.E.

William A. Springer, P. E.

WAS:est

(b) (6) [redacted]

NEW ORLEANS LA 701
PM
22 OCT
1998

BREAST CANCER
FUND THE FIGHT
FIND A CURE
USA First-Class

John Martin (65F-R2)
Environmental Protection Agency
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202

75202X2733 54

July 7, 2000

[redacted]

CERTIFIED MAIL - RETURN RECEIPT REQUESTED
Z 241 144 693

John Martin (65F-R2)
Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

Dear Mr. Martin:

On December 15, 1999, at your direction, Greg from the Corps of Engineers, came to inspect and estimate the damages our home began to show after the EPA's removal of asbestos took place. At that time, Greg advised us that he did not think our claim was "unreasonable" and stated that he <u>would recommend</u> to you that leveling of the house, and the necessary repairs, be made by the EPA. He stated the EPA would be in contact with us after the first of the year to coordinate the repairs to be done.

Having not received word from you, or any EPA representative, an attempt to contact you was made at the end of March, 2000. However, the local telephone number you had given had been disconnected.

On April 6, 2000, a message requesting a return call was left for you at your Dallas office. On April 7, 2000, another attempt to reach you at your Dallas office was successful. At that time, you said that Greg <u>did not recommend</u> that the EPA repair the damage. However, you seemed confused and said that you would talk with Greg again. You also said that you would send the latest decision in writing "soon".

As of this date, we have not received any correspondence from you.

Please send to us, in writing, the EPA's final decision on our claim, within thirty (30) days from the date of this letter.

Sincerely,

[redacted]

[redacted]

(b) (6)
[redacted]

CERTIFIED

Z 241 144 693

MAIL

U.S. POSTAGE
PAID
HARVEY,LA
70058
JUL 07 '00
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$0.00
00012485-13

RETURN RECEIPT
REQUESTED

John Martin (65F-R2)
Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202

75202

UNITED STATES POSTAL SERVICE

9264

75202-2733 54

STRUCTURAL ENGINEERING REPORT

[redacted]

98-444S

AUGUST 4, 1998

Prepared For

INTERNATIONAL TECHNOLOGY CORPORATION

Prepared by

GILBERT ENGINEERING AND INSPECTION SERVICES
405 GRETNA BLVD. - SUITE 209
GRETNA, LOUISIANA, 70053
(504) 365-0175

Certified by

James G. Gilbert, P.E.
Louisiana Registration # 14417

STATE OF LOUISIANA
JAMES G. GILBERT
REG. NO. 14417
REGISTERED PROFESSIONAL ENGINEER IN CIVIL ENGINEERING

Gilbert Engineering & Inspection Services
405 Gretna Blvd. Suite 209 Gretna, La. 70053
(504) 365-0175

STRUCTURAL ENGINEERING REPORT

[redacted]

INTRODUCTION

August 4, 1998 a visual inspection[1] was made of the readily accessible structural components and systems of the above property:

1. To assess the structural integrity of the building;
2. To determine if any differential settlement has occurred;
3. To determine if the cosmetic damage to the building and a portion of the differential settlement could be associated with the removal of asbestos contaminated soil on the right side of the building; and
4. To determine the need for and to recommend remedial work.

The inspection included the yard, the readily accessible and visible portion of the foundation, the driveway, the exterior and interior of the house, the attic and the detached garage. A review was made of the videos made prior to and upon completion of the excavation of the soil. Directions used in the report are given as facing the building from the street.

The report is prepared for the exclusive use of the client and presents the results of the inspection and an overview of the structural condition of the property. *The General Comments and Constraints Appendix includes the scope and limitations of the inspection. It also includes a discussion of settlement in the Greater New Orleans area, remedial foundation work, typical structural problems and cracking of reinforced concrete slabs. The Effect of Vibrations on Residential Buildings Appendix discusses the methods in which construction vibrations can effect residential and light commercial properties. The Appendices are important parts of this report and a portion of the Recommendations and Conclusions are on the information contained in the Appendix.*

The term "relative elevations" is used in the report to describe the flatness of the foundation and is not associated with flood elevations or other elevations which describe the height of the foundation relative to sea level or other standard references. The term "structurally sound" means that the primary structural components appear capable of transmitting the applied live and dead loads to the soil without failure. While structural soundness and differential settlement are closely related they are discussed as separate topics in the report.

BACKGROUND INFORMATION

International Technology Corporation removed asbestos contaminated soil from the driveway to the right of the house during the summer of 1997. The work consisted of removal of approximately 6" of soil between the house and the fence. Some material under the house, and around the garage was also removed. The majority of the soil was removed mechanically. The soil below the house and in the confined areas was removed by hand. The area was filled with crushed stone. A concrete slab was also poured in the driveway area. The work was started in June 1997 and completed by the end of July 1997.

The owner of the house noticed cracking in the new slab in early August. Shortly afterward, a bow was observed in the right wall of the house and cracks developed in the sheetrock. The owner indicated that there had been previous cracking of the sheetrock, but most of the cracks observed, particularly along the left side were new, not old cracks which had re-opened.

OVERVIEW

No structural damage to the building was observed. There is extensive cosmetic damage to the interior sheetrock. It could not be determined whether or not the construction activities contributed to the cosmetic damage; however, nothing was observed that suggests that construction activities were a major factor in the damage to the building. If the construction activities did contribute to the damages, it is most likely the damage would have been caused by construction vibrations. The probability that the construction activities contributed to the cosmetic damage and differential settlement can be better determined by soils testing and vibration measurement.

The condition of the building is discussed in the Inspection Section. Ways in which the construction activities could have effected the building and the cost estimate are discussed in the Recommendations and Conclusions and Appendices.

PHYSICAL DESCRIPTION

The subject is a one story frame residence, which appears to be approximately 40-50 years old. The building was furnished and occupied at the time of the inspection. Table 1 contains a summary of the primary physical characteristics of the property.

TABLE I
PHYSICAL DESCRIPTION

Type Construction:	One story frame residence.
Age:	Approximately 40-50 years.
Sidewalks:	Concrete.
Driveway:	Gravel and crushed stone.
Patio:	Concrete.
Porches:	Concrete front porch supported by concrete block.
Car Storage:	Single detached metal garage.
Foundation:	Pier and beam system.
Exterior Walls:	Wood.
Roof:	Asbestos shingles.
Trim:	Wood.
Gutters:	Metal.
Attic:	Accessible by folding stairs.
Framing:	Conventional. 2x6 rafters at 24" o.c., 1" wood roof sheathing.
Interior Walls:	Sheetrock.
Ceilings:	Sheetrock.
Flooring:	Primarily wood.

INSPECTION DATA

Foundation:

The foundation is a pier and beam system which does not appear to be pile supported. The soil is this area is classified Type 17 on the Jefferson Parish Soil Survey Map. However, the type of soil in this area changes to Type 13 in a relatively short distance.

Type 17 soil is a silt loam with an allowable design load of 2000 psf and Type 13 is a relatively soft clay with an allowable design load of 1000 psf. The actual soil characteristics can not be determined without soils testing.

The foundation and associated framing were inspected from the perimeter and crawl space of the building. The visible portion of the foundation and framing consisted of portions of the piers, the sills, subflooring and floor joists. The footings were not visible.

The visible portion of the foundation and framing appears in generally satisfactory condition. There are minor chips in the block piers along the right side. The chips have occurred since the piers were painted.

There is some cracking of the concrete block piers, particularly along the left side and in the concrete block chain wall across the front. There was paint in several of the cracks, indicating the cracks occurred prior to the concrete blocks being painted. There is some relative movement between the concrete block front porch and the house.

The soil under the crawl space along the left side was damp at the time of the inspection. The soil in the crawl space is generally lower than the surrounding ground, particularly along the left side and front. It appears that water is running and standing under the house. Water marks on the piers indicate the water has been standing up to 2" deep. There is mildew on the front piers and concrete block chain wall indicating the water is being trapped by the chainwall.

Relative elevations[2] were taken and are presented in Figures 1 and 2. The relative elevations, which are discussed in the Appendix, show the elevation in inches of selected points of the foundation relative to the lowest point measured (i.e. the elevation at the lowest point is set equal to 0"). Figure 1 shows the value and location of the relative elevations. Figure 2 is a plot of the relative elevations from front to rear.

The foundation slopes downward from the rear to the front. The high points are along the right side. The low points are near the center at the front of the house.

The total differential is 2.4". Approximately 63% of all pier and beam foundations in the Greater New Orleans area have differentials of 2.4" or more. The average differential for all foundations in the New Orleans area, south of the lake but excluding the River Parishes, is 3.17".[3] The average for pier and beam foundations is 3.45". The average differential in this portion of the Greater New Orleans area (MLS areas 041-043) is 2.47".

The slope between the closest high and low points is 0.120" per foot or 1 3/16" in 10'; however, the slope changes significantly from front to rear as shown in Figure 2. The average slope measured during routine structural engineering inspections is 0.085" per foot or 7/8" in 10'. The average slope in this area is 0.073" per foot or 3/4" in 10'. Evaluation and comparison of the differential settlement of foundations should include not only the total differential, but should also consider the distance between the high and low points which is reflected in the slope data. The Appendix discusses the comparison of total differential and slopes in more detail.

Exterior:

The exterior walls are in generally satisfactory condition. There are several gaps at the joints of the wood siding and trim. The gaps appear to have developed since the building was painted.

Interior:

There is extensive cracking of the interior sheetrock. The most severe cracking is along the right side.

Attic:

The visible attic framing and roof sheathing appear sound, in satisfactory condition and properly braced. The framing joints appear sound and tight. No roof leaks were observed; however, a comprehensive examination for roof leaks was not a part of this inspection.

Yard, Sidewalks, Driveway and Garage:

The yard and exterior concrete are in satisfactory condition. There is minor to moderate cracking and minor settlement of the exterior concrete. The detached garage appears sound.

RECOMMENDATIONS AND CONCLUSIONS

The residence appears basically sound but has extensive signs of distress. The signs of distress appear to be due primarily to the differential settlement of the foundation. As discussed below, it is not possible to determine the extent, if any, that the construction activities contributed to the differential settlement and the signs of distress.

Settlement Considerations:

The variation in relative elevations appears to be due primarily to differential settlement of the foundation. The differential is less than the average measured during routine structural engineering inspections in the Greater New Orleans area. The differential settlement does not appear to have caused any significant structural damage to the building at this time and significant damage to structural components is not considered probable in the foreseeable future, assuming normal settlement scenarios as discussed below and in the Appendix.

The amount of cosmetic damage is significantly higher than would normally be associated with this amount of settlement. This appears to be due primarily to the age of the building and the pattern of settlement (i.e. significant changes in relatively short distance.)

The majority of the settlement during a primary settlement cycle normally takes place early in the life of the residence and stops for all practical purposes or reaches an acceptable rate after several years, see Section 3.0 of the Appendix. After the primary settlement cycle is completed, secondary settlement usually continues throughout the life of the property at a low rate and does not normally become a significant factor until the residence becomes relatively old.

There are other factors which can cause additional settlement. These include, variations in the moisture content of the soil and vibrations. Some foundations, particularly those which are not on pilings and where the soil has a high clay content, may experience movement as the soil below the foundation expands or contracts due to changes in the water content of the soil. Numerous foundations in the Greater New Orleans area have experienced unanticipated movement during the extended period of dry weather which occurred in the summer and fall of last year and the spring and summer of this year. The pattern of settlement suggests that the water standing under the house is probably a significant factor in the settlement of the foundation. Soils testing is necessary to determine the extent to which the dry weather and water standing under the house may have contributed to the differential settlement.

Construction Activities:

Construction vibrations can contribute to cosmetic damage is several ways, as discussed in The Effect of Vibrations on Residential Buildings Appendix. The two most likely ways the construction vibrations could have effected the building are exciting the natural frequency of the walls and ceilings or by causing additional differential settlement. The finish materials in building such as this are stressed for several reasons, but primarily the differential settlement. In addition, the strength of the materials may decrease with age. As a result, relatively small vibrations can cause cracking.

There is insufficient information to determine whether or not this is the case for this residence. The magnitude of ground movement at any distance due to vibrations is a function of the attenuation factor of the soil. Ground vibrations will carry further in stiff clays than in sand or silty soils. The attenuation factor of the soils and the predominate frequency of the construction equipment can be determined by making vibrations measurements with equipment similar to that used at the site. Once the attenuation factor the soil and the predominate frequency of vibration are known, the effect the vibrations may have had on the building can be better assessed.

Construction vibrations can cause differential settlement in some instances. This is usually due to consolidation of loose layers of sand. The type soils shown on the soils survey map in this area are clays which are not significantly effected by vibrations. Soils testing would be necessary to demonstrate that this is a factor.

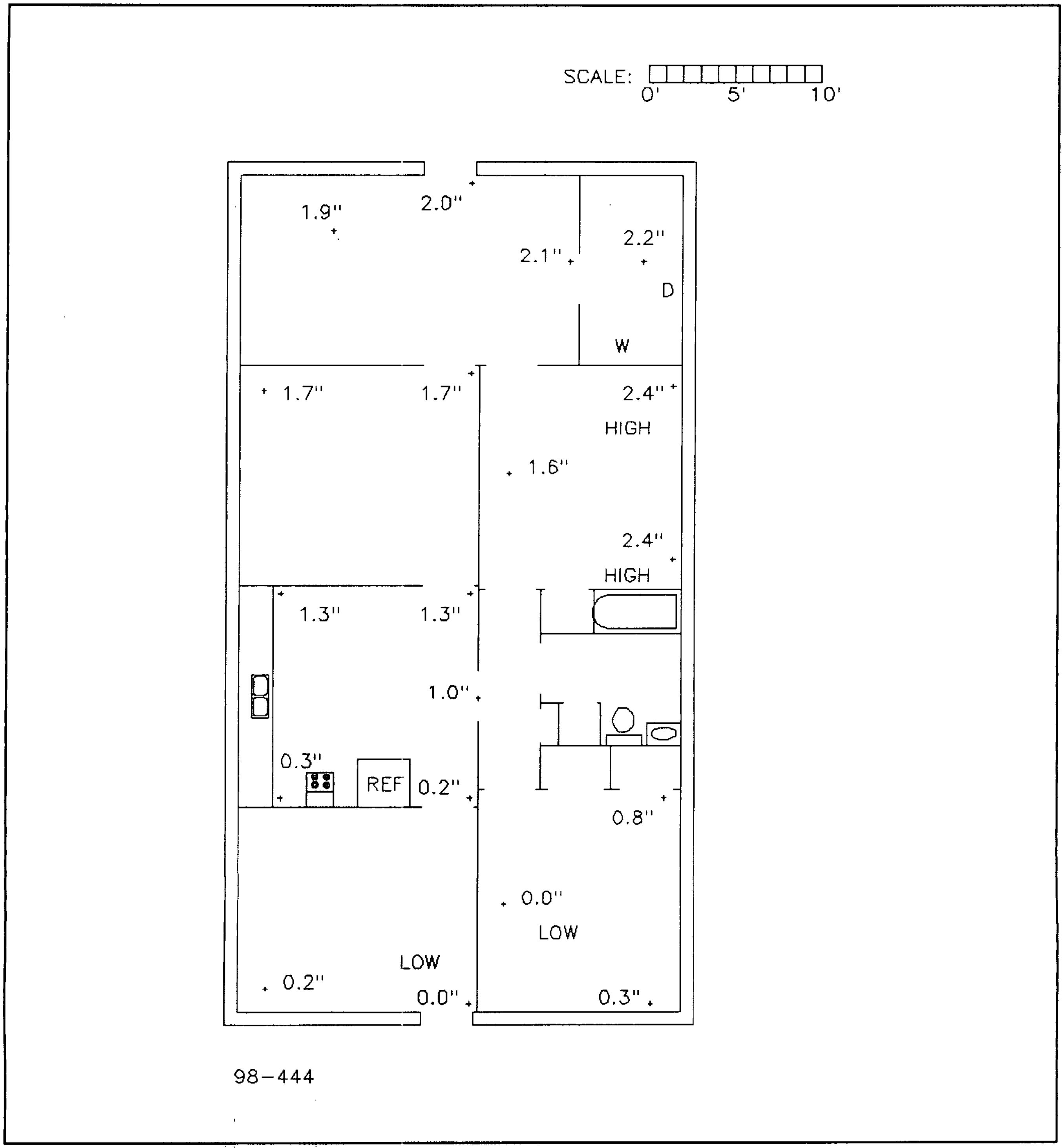

Figure 1 - Relative Elevations
[redacted]
August 4, 1998

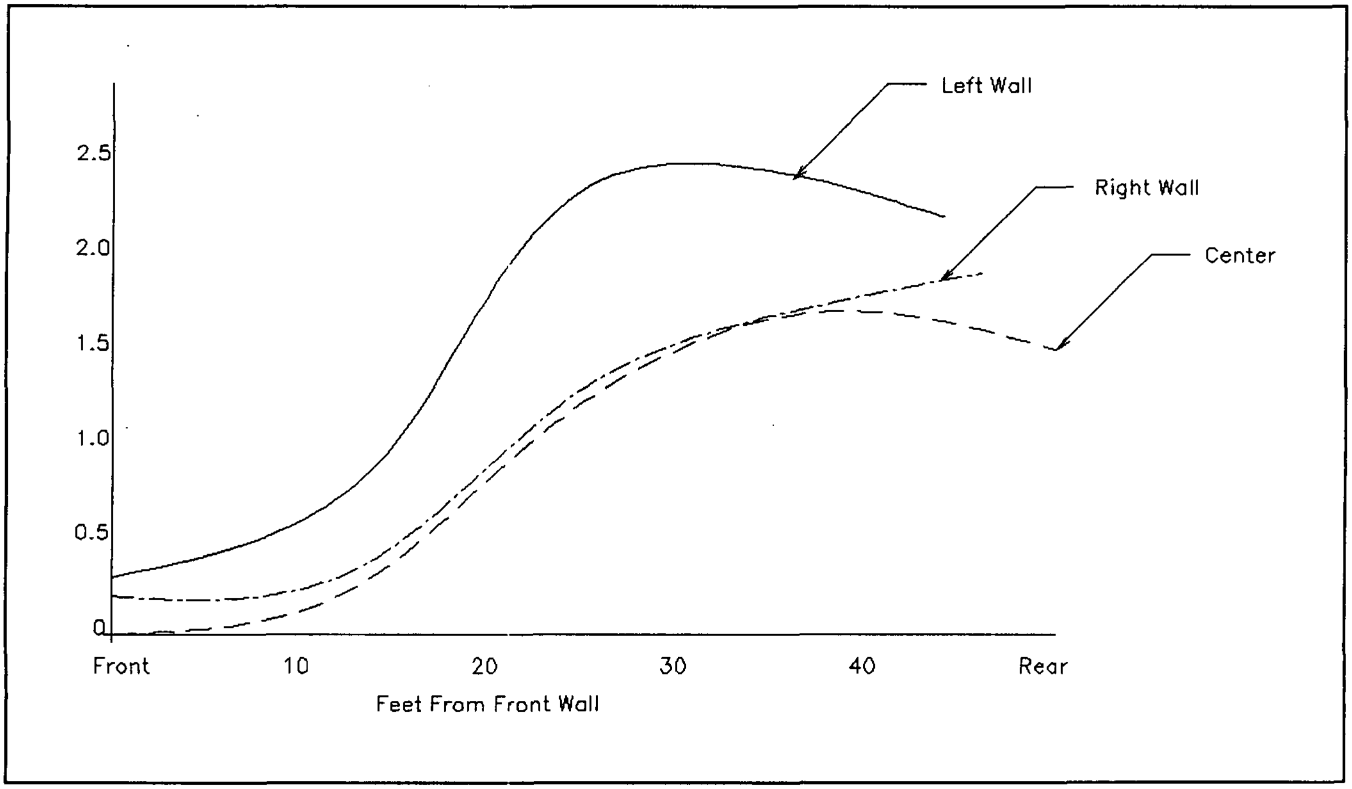

Figure 2 - Relative Elevations - Front to Rear
[redacted]
August 4, 1998

RIGHT FRONT VIEW

LEFT FRONT VIEW

REAR VIEW

GARAGE

RIGHT SIDE PIERS

CHIPPING OF RIGHT PIER

CHIPPING OF RIGHT PIER

CRACKING OF LEFT PIER (Note Mildew On Pier)

WET AREA ON LEFT SIDE (Note Mildew On Pier)

CRACKING OF CONCRETE BLOCK CHAINWALL

GAPS IN SIDING

INTERIOR CRACKING

Gilbert Engineering & Inspection Services
405 Gretna Blvd. Suite 209 Gretna, La. 70053
(504) 365-0175

INTERIOR CRACKING

INTERIOR CRACKING

INTERIOR CRACKING

INTERIOR CRACKING

INTERIOR CRACKING

Gilbert Engineering & Inspection Services
405 Gretna Blvd. Suite 209 Gretna, La. 70053
(504) 365-0175

1. The inspection was performed in accordance with ASCE 11-90, *Guideline for Structural Condition Assessment of Existing Building,* published by the American Society of Civil Engineers, August 1, 1991.

2. The relative elevations were taken with a Compulevel, Elevation Measuring System, manufactured by Stanley Tools.

3. Comparative data is taken from Differential Settlement Analysis of Residential Properties in the New Orleans Area, dated July 31, 1990, Revised January 3, 1994, by James G. Gilbert, P.E. as well as unpublished data contained in the Gilbert Engineering data bank.

STRUCTURAL ENGINEERING REPORT APPENDIX GENERAL COMMENTS AND CONSTRAINTS

1.0 PURPOSE

The appendix outlines the inspection scope process, the limitations of the structural engineering inspection and report, and provides background information to assist in the evaluation of the property. The inspection and report are designed to identify the more common structural problems found in building construction, to *explain possible causes of foundation variations and to provide the reader with an insight as to future settlement conditions based on typical settlement scenarios as outlined in this appendix.*

The scope of the inspection and the report is limited. Buildings are complex structural systems with many concealed components. To accurately determine the cause of existing settlement conditions; to project future settlement; and to completely determine the structural integrity of the a typical building, requires extensive engineering examination, testing and analysis which are usually considered to be cost prohibitive for most residential inspections and are outside the scope of this inspection and report.

- Verifying the structural integrity of the building assuming typical construction methods and compliance with the applicable building code;
- Determining if significant differential settlement has occurred;
- Determining if conditions exist which might result in additional significant settlement, assuming typical soil conditions and settlement scenarios; and
- Determining possible remedial action.

TABLE I
EMPHASIS OF THE INSPECTION

2.0 SCOPE

2.1 Emphasis of Inspection:

Foundation problems are the most common structural problem found in residential and light commercial construction in the New Orleans area. For this reason, the primary emphasis is on foundation and settlement related problems. Foundation problems are common in all parts of the United States. In the New Orleans area, problems are most often associated with settlement. Where as in other parts of the country, foundation problems are often associated with expansive clays and geological faults. Expansive clays do cause some problems in this area, but this is the exception rather than the rule. The inspection is limited to a visual inspection of the readily accessible portions of the building as outlined in the Inspection Procedure Section. The emphasis of the inspection is summarized in Table I.

2.2 Structural Components:

For the purpose of this report, the structural system is considered to consist of the primary load carrying parts of the building which transfer loads imposed on the building to the soil. These generally include the roof sheathing and framing, the exterior and load-bearing wall framing, and the foundation system and associated framing. Table II summarizes primary structural components.

The foundation system is the part of the structure which transmits the loads to the ground. A portion of the foundation is in contact with the ground. The most common types of foundations in the New Orleans area are pier and beam, reinforced concrete slabs, and raised foundations such as the older raised houses. Some buildings have combinations of two or more of these systems. Pilings may or may not be used as a part of any of these systems.

Non structural parts of the building, such as the shingles, brick veneer, wood trim and other finish materials are important parts of a building, but they are not major load carrying members. Signs of distress in these materials may be useful in the evaluation of the structural condition of the building. The description of signs of distress, particularly cracking of the masonry, may be included in the report for future reference. Other discrepancies, such as rotted or damaged finish materials, which do not effect the structural integrity of the building may be mentioned in the report for the convenience of the client. They are not part of the formal inspection. Only repairs of finished materials required to protect structural members are normally recommended. Other repairs are at the discretion of the client.

Items such as patio covers, detached carports, storage buildings and other structures which are not part of the main building are excluded from the inspection. Information is may be provided on these areas for the convenience of the client. However, this information is not to be interpreted as an inclusion of the item as part of the inspection unless specifically noted in the report.

- Roof Sheathing
- Roof Rafters and Bracing
- Ceiling Joists
- Load-Bearing Walls
  - o Studs and Plates
  - o Some masonry walls
- Foundations and Associated Framing
  - o Reinforced Concrete Slabs
  - o Floor Joists
  - o Sills and Beams
  - o Piers
  - o Columns
  - o Footings
  - o Pilings

TABLE II
STRUCTURAL COMPONENTS AND SYSTEMS

2.3 Design of Remedial Work:

General recommendations for repairs required due to structural or settlement problems may be included as a part of the inspection and report. They are not intended for construction purposes without more detailed information. Cost estimates, detailed designs for remedial work, reinspection, construction inspections and certification of completion of the work are available as part of our services, but they are not included as part of the original scope of work unless specifically stated.

3.0 SETTLEMENT

3.1 Background:

Settlement consists of the downward movement of the foundation caused by changes in subsurface conditions. Upheaval or upward movement caused by the expansion of soil is also included as part of the settlement phenomenon in this discussion. For the purpose of this report, settlement is considered to be caused by or to consist of:

- Primary settlement cycles;
- Secondary settlement or long term consolidation;
- Decay of organic materials; and
- Movement due to the consolidation or expansion of soils brought on by changes in the moisture content of the soil.

Settlement is a complex phenomenon and a function of many factors, including such factors as the type of soil below the foundation (including the chemical composition, organic content, and grain size and shape); soil preparation during construction; the foundation design; the depth of the water table; the moisture content of the soil; and near by construction. Accurate measurements over an extended period of time as well as detailed soil data are required to determine if the settlement has stopped for all practical purposes or reached an acceptable rate.

In most instances, it is possible to assume from the age of the property, typical settlement scenarios and the general history of the neighborhood around the property, whether or not significant settlement should be expected in the future. ***However, because of the complexities involved, there is always the risk that the actual future conditions may vary dramatically from those assumed.*** In some instances, it is not possible to make such assumptions and more accurate measurements over an extended period of time may be recommended.

3.2 Differential Settlement:

Most foundations in the New Orleans area experience settlement. Ideally, the amount is small and the foundation settles uniformly at an acceptable rate. The primary concern in residential and light commercial construction is usually differential settlement where the foundation does not settle uniformly. Differential settlement can be caused by several factors including but not limited to, load distribution in the building, the foundation design and soil distribution below the foundation. Differential settlement occurs in both pile supported foundations and those without pilings.

Excessive settlement, particularly differential settlement, is considered to be a structural failure since a primary design criteria is that the foundation transmit the loads to the soil without excessive settlement. Excessive settlement or differential settlement is considered as evidence that the foundation is not or was not capable of properly transmitting the applied loads to the soil. Unlike most structural failures, the foundation usually becomes stable at some point in time and is then capable of transmitting the applied loads to the soil with little additional settlement. For this reason, the settlement of the foundation is addressed as a separate topic from other structural problems in the engineering report.

If the foundation design exceeds the safe load capacity of the soil, then the settlement scenario may vary dramatically from the typical scenario discussed here. In these instances, stabilization of the foundation may not occur until significant damage to structural components has occurred or the functional use of the building is significantly jeopardized.

3.3 Primary Settlement:

The majority of the settlement is assumed to result from primary settlement. Primary settlement normally takes place during the early life of the structure and the settlement rate reaches an acceptable level after 4 or 5 years. At this point, the foundation is usually capable of carrying the imposed loads with little additional settlement.

Studies of soils in the New Orleans area show that while there is a wide range of soil conditions and anticipated settlement, 50 to 70% of the settlement takes place within the first year after the soil is loaded, 70 to 85% within the first 2 years and 85 to 95% within 5 years, see Figure 1. The time required for the settlement cycle may be longer and the amount of settlement higher in poorer soils such as abandoned distributories and undrained land. Even in these cases, the majority of the primary settlement is expected during the first five years after the beginning of the settlement cycle.

Additional primary settlement cycles can be initiated by changes in the loads on the soil (i.e. construction of additions) and by changes in subsurface conditions, particularly significant lowering of the water table since the moisture content of the soil is an important factor in the strength of the soil and settlement. The water table usually drops after a subdivision is developed because of higher runoff and improved drainage. After a few years, the water table stabilizes at a lower level and remains at this level until other subsurface changes occur. One of the most common causes of subsurfaces changes is improvement of the drainage system.

3.4 Secondary Settlement:

Secondary consolidation or settlement is assumed to begin near the end of the primary settlement cycle. It is thought to result from the compression of soil particles at a microscopic or molecular scale. It is particularly common in organic soils as exist throughout the New Orleans area and South Louisiana.

Secondary settlement normally occurs at a lower rate than primary settlement and does not become a significant factor in the total differential of most foundations until the homes are relatively old.

3.5 Decay of Organic Materials:

The decay of organic particles in the soil is a major factor in total settlement of residential foundations in the New Orleans area. A large portion of the land used for residential construction in the area is reclaimed swamps and marshes with soils which have a high organic content. As the organic material decays, the soil consolidates, resulting in additional settlement. The lowering of the water table usually speeds up the decaying process.

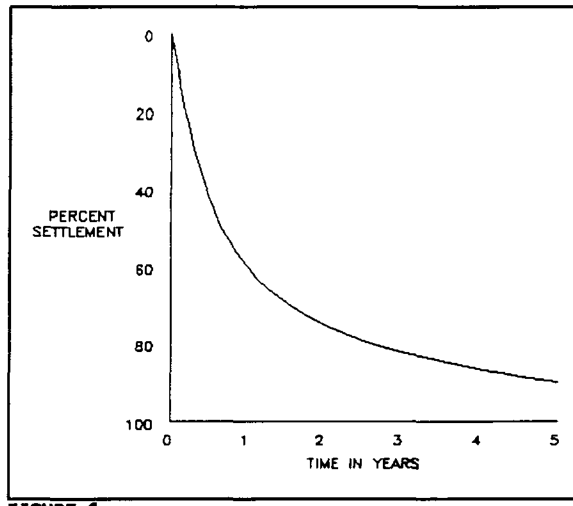

FIGURE 1
TYPICAL SETTLEMENT SCENARIO

3.6 Changes in Moisture Content:

The strength of the soil and the amount of settlement will vary with the moisture content. The strength of the soil increase as the moisture content increases. Once the moisture content reaches the optimum point, the strength of the soil decreases, in some instance dramatically.

The moisture content of the soil may vary due to extended periods of wet and dry weather or prolonged changes in the water height of the river, if the property is near the river. Changes in the moisture content can cause compaction and settlement and, in some instances, expansion of the soils. The change in the moisture content appears to occur most often in homes which are not on pilings. The most common effect is for older homes to begin to experience additional settlement after it appears that the foundation has stabilized and the settlement reached an acceptable level. This condition occurs through out the New Orleans area, particularly after extended periods of dry weather. The condition occurs most often in homes which have already experienced some differential settlement. However, instances are documented where movement has occurred where the foundation has experienced only small amounts of differential settlement.

In some instances, the amount of differential settlement may decrease due to expansion of the soil. These conditions are most likely to occur in homes which are not supported by pilings, particularly when the soil has a high clay content. During periods of dry weather, the soil around the foundation should be watered sufficiently to prevent cracking of the soil or cracks developing between the foundation and the soil.

Excessive amounts of water can be as damaging or more damaging than lack of moisture. Excessive water can greatly reduce the load carrying capacity of the soil and in some instances, reduce the load carrying capability of piles. The yard around the building should be graded to provide proper drainage of water away from the foundation. Water should not be allowed to run or stand under a foundation.

3.7 Trees and Plants:

The effect of plants, particularly large tree near foundations is not fully understood. It appears that in most instances trees pose no real threat to foundation stability other than that normally associated with plants and shrubs. Typical ways in which trees near a building can effect the foundation and/or exterior concrete around the building are summarized in Table III.

- The root system can reduce the moisture content of the soil, particularly during periods of dry weather.
- The system of roots reinforce the soil and can help prevent settlement.
- The roots can displace the concrete, particularly sidewalks and driveways.

TABLE III
TYPICAL WAYS IN WHICH TREES CAN EFFECT FOUNDATIONS

Excluding changes in the water table, the decreases in the moisture content of the soil near the surface is caused by either evaporation or the removal of water from the soil by vegetation (transpiration), particularly trees. In many instances, the loss of water due to trees and shrubs may exceed the loss by evaporation. The extent to which this loss effects foundations has not been clearly demonstrated.

The water used by trees and shrubs is absorbed by the root hairs near the ends of the roots that are near the surface. The roots are generally assumed to extend to near or slightly beyond the furthermost extension of the limbs. The majority of the moisture absorbed by the roots is absorbed by the outer portion of the root system. The loss of moisture does not tend to effect the foundation if the moisture taken from the soil can be easily replaced or unless the tree is very close to the foundation.

The roots of trees which grow near a building after the foundation is constructed do not normally extend under the slab if the outer grade beams are 2' or more deep. This is because the roots which absorb the moisture grow near the surface. If a foundation is built over a tree root system, the roots will continue to draw water from under the foundation. Any negative effect of the reduction in moisture level of the soil maybe off set by the matting effect or reinforcement of the soil caused by the root system. In addition, the shade of the tree often reduces the loss of moisture from the soil due to evaporation.

During dry weather, the soil around the foundation and particularly around trees and shrubs should be watered sufficiently to prevent the soil from drying out and cracking. In addition, trees should not normally be planted closer to a foundation than the anticipated height of the tree when grown. Trees considered to have high water demands are mature oaks, elms and willows with trunk diameters of 3' or more.

3.8 Other Factors:

Settlement may also be caused or increased by other factors such as the type and amount of fill; deterioration of pilings; nearby construction, such as excavations associated with the installation of sanitary or storm sewer improvements; problems associated with broken or leaking water mains and sewer systems; and vibrations from nearby traffic.

4.0 MEASUREMENT OF SETTLEMENT

4.1 Relative Elevations:

For the purpose of this report, differential settlement is measured using the relative elevations of the foundation. This method ignores total settlement of the foundation. A reference point on the foundation is selected and the height of other points are given relative to the reference. Unless otherwise noted, the low point is selected as the reference (i.e. the elevation of the low point is set equal to 0") and the other elevations shown as positive numbers. See Figure 2. Characteristics of relative elevations are summarized in Table IV.

Negative numbers are usually used to show relative elevations in engineering work; however, they are shown as positive numbers in these reports since most nontechnical readers prefer this method. Negative numbers are sometimes used to facilitate comparison of previous data with recent data or in instances where it may be desirable to show points lower than the reference point, such as recessed slabs. Negative numbers are indicated either by a minus sign or by placing the number in parenthesis.

Relative elevations are included to give an indication of differential settlement. They are taken on the finished floor surfaces with a water level and corrected for temperature changes and variations in the thickness of floor finishes to the extent practicable, unless otherwise noted in the report. The measurements are assumed to be accurate to plus or minus 1/4". The repeatability may not be this accurate due to factors including, but not limited to, wear of floor finishes, foreign materials below floor finishes and normal variations expected in field measurements. The differential between the high point and the low point is verified after all other readings have been taken.

Relative elevations may be taken on the exterior by measuring the relative elevation of the brick ledge. Variations of 1" or more between relative elevations taken in this manner and those taken inside the home are not unusual. The difference between the two is usually due to the way in which the foundation and walls are constructed.

4.2 Slopes:

The size of the foundation and the distance between the high and low points should be considered in evaluating differential settlement. The slope is usually included in the report to facilitate the evaluation. Unless otherwise noted, the slope is the average slope calculated by dividing the total differential by the distance between the high and low points. If there are multiple highs and/or lows, the slope is usually measured between the closest high and low. Other slopes may be included if the slopes vary significantly throughout the building.

The slope is expressed in inches per foot. This is the vertical distance of the foundation changes in one foot. Since this is a small number which is hard to visualize, the slope is also expressed in inches per ten feet.

The slope of the foundation is useful in comparison of the differential settlement of large and small foundations, but should be used with discretion. The slope can be significantly affected by relatively small changes in relative elevations and distances. This is particularly true when the distance between the high and low points is short and/or the variations in relative elevations are small.

4.3 Other Causes Of Variations In Relative Elevations:

Variations due to causes other than differential settlement are not unusual. They may be due to construction methods, including variations in tolerances for construction materials, and deflections due to live and dead loads. It is often difficult to distinguish these variations from those caused by settlement.

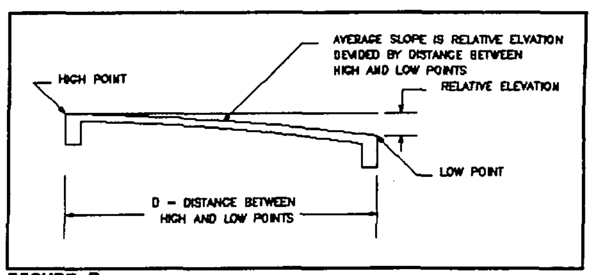

FIGURE 2
RELATIVE ELEVATIONS

There are no uniformly accepted tolerances for how level a residential foundation should be constructed. Plus or minus 1/2" (1" total variation) is a commonly accepted tolerance for commercial construction based on various technical specifications. Variations larger than this are the rule, not the exception, for residential construction, particularly for foundations constructed at two or more levels or which have unusual shapes. Pier and beam foundations may vary more than slabs due to the larger number of items in the construction which effect finished floor elevation, (i.e spread footings, piers, sills, floor joists, and subfloors.)

All foundations are flexible to some extent and the foundation may deflect due to normal live and dead loads. Under the American Concrete Institute Building Code, deflections due to live loads of up to 1/2" in 10' are allowed under certain conditions. Similar or larger deflections for pier and beam foundations are allowed under most building codes for certain conditions.

- Relative elevations show the height of the foundation relative to a specific point on the foundation, usually the relative elevation indicates the height above the low point.
- Relative elevations are usually taken inside the house with a water level.
- Relative elevations are accurate to ± 0.25" but the repeatability may be more than this.

TABLE IV
CHARACTERISTICS OF RELATIVE ELEVATIONS

4.4 Comparative Data:

The report may include percentages comparing the inspected foundation with others in the New Orleans area. The comparisons are based on analyses of data obtained by Gilbert Engineering during structural inspections. The information should be used only as a general indication of how the foundation compares to others in the area. The percentages are based on total variations and do not reflect any consideration as to the size of the foundations. The average slope is usually included in the report, which can be compared to the average in the New Orleans area. However, as discussed previously, this should be done with discretion since the slopes can be misleading in some instances.

Copies of the report on Differential Settlement in the New Orleans area are available upon request. The report shows the average and median differential by geographic areas, percentage distribution of differentials and average slope.

5.0 CRACKED SLABS

Most concern about a "cracked slab" is unfounded. A characteristic of concrete is that it cracks. One of the purposes of the reinforcing in a slab is to control the number and size of the cracks. For this reason, post tension reinforcing is often used in residential and light commercial slabs because the process tends to minimize visible cracks in the slab.

The primary cause of concrete cracking is thermal stresses generated during the chemical reactions which occur during the curing of the concrete. During the life of the slab, additional cracking may occur for a number of reasons, including differential settlement. As a foundation settles and/or goes through heating and cooling cycles, the existing cracks tend to grow and more cracks become visible. As a general rule, these cracks do not significantly affect the load carrying capability of a properly reinforced concrete foundation and repairs are not required for structural reasons.

Almost all reinforced concrete residential and light commercial slabs have visible cracking, particularly common are cracks in the surface or sides and at the corners. These conditions are common and do not usually effect the structural capacity of the foundation or present problems with allowing water or insects into the building. However, instances of termites and water entering a building through cracks do occur and it is prudent to seal cracks when finished floor materials are being replaced. This can be easily done with an epoxy patching material.

It is not uncommon for cracks in the slab to penetrate floor finishes such as ceramic tile or brick pavers, particularly if the finish floor material is bonded directly to the slab. Installation on a thick bed of mortar will usually reduce the amount of visible cracking.

6.0 REMEDIAL FOUNDATION WORK

6.1 Remedial Work Considerations:

This section summarizes considerations in determining whether remedial foundation work is required or desirable. Remedial methods are discussed briefly. A comprehensive discussion of remedial foundation work is outside the scope of this report. More detailed information on remedial foundation work is available upon request. Engineering design and inspection services are available if desired.

Remedial foundation work for residential and light commercial foundations usually consists of underpinning the foundation. The work may or may not include leveling of the foundation. Underpinning consists of installing additional support below the existing foundation.

The process in determining whether or not to undertake remedial foundation work due to settlement is complex since the decision involves technical, economic, marketing and emotional considerations. The technical considerations which are addressed in the engineering report are summarized in Table V. When the answers to these questions are favorable, leveling and remedial foundation work is not required for structural reasons. This is the case with most homes inspected, including those with relatively high differentials.

This does not mean that remedial foundation work not may be desirable or required for nontechnical reasons such as financial, marketing, or aesthetical considerations. Most remedial foundation work is done for these reasons rather than technical reasons. The decision based on nontechnical reasons is outside the scope of the engineering inspection and report.

The cost and difficulty will vary from foundation to foundation. As a result, there is one rule which should not be ignored casually when consideration is being given to purchasing residential or light commercial properties which have a high amount of differential settlement. That is simply:

If the building is to be purchased with the intent to perform remedial foundation work or leveling, an estimate of the cost of the remedial work should be obtained from one or more qualified contractors.

6.2 Pier and Beam Systems:

Pier and beam foundations are usually relatively inexpensive to repair and level. The work consists of jacking the house and providing proper support using the existing piers and sills. Additional sills and piers may be required. The cost will be affected, often dramatically, by such factors as brick walls, the size of the building, chainwalls, the number of stories and the need for pier or sill repairs.

6.3 Reinforced Concrete Slab Not On Piles:

Remedial work on reinforced slabs not on pilings will normally consist of underpinning and/or leveling of the slab. Until recently, most underpinning of slabs not on piles was done using poured concrete piles and caps. This method is still widely used throughout the New Orleans area and works effectively in some conditions. However, it is difficult to predict the extent of any future settlement using this method.

The jacking of segmented piles under the existing foundation has recently become cost effective. This method has the advantages that the loads on the piles are known and much longer piles can be installed. This not only improves the design considerations, but reduces the possibility of future settlement.

Screw jacks or helical anchors have also been used successfully in the area to underpin foundations. This method is discussed below.

A common practice is to underpin only a portion of the slab to reduce the cost. This approach may result in a higher probability of additional settlement due to considerations which are outside the scope of this report. With any method, the best approach to minimize future differential settlement is to underpin the majority, if not all, of the foundation. Unfortunately, this may become cost prohibitive.

The cost of remedial work will depend upon factors such as:

1. The number and location of the additional footings;
2. The location of adjacent improvements such as carports/garages/driveways, the size of the foundation; and
3. The extent to which it is desired to level the house.

6.4 Reinforced Concrete Slabs On Piles:

Remedial work on reinforced slabs on pilings is complex and expensive, almost without exception. For this reason, until recently, it has been considered economically unfeasible to level foundations on piles. In many instances, this is the case.

Typical remedial work consists of excavating under the existing foundation to expose the main support beams, installing additional piles under the existing foundation and/or extending and jacking the existing piles; construction of a reinforced concrete strip footing supported by the new and/or existing piles; jacking the foundation to the desired position; and installing piers or a chainwall between the new and old foundations and backfilling around the building.

There are numerous variations to the above approach, including omitting of the jacking and leveling process if the foundation is only under pinned. Other variations include the use of screw piles or helical anchors discussed below.

6.5 Other Systems:

Recently a system where the moisture content of the soil is controlled has been developed and may be effective in certain soils. However, there is still considerate debate in technical circles as to the effectiveness of this method. After soil samples indicate that the system is applicable to the existing soil conditions, a water injection system is installed which maintains the moisture content of the soil within the desired range. While this system may result in some leveling, it should be considered for stabilization purposes only.

- Future Settlement - Has the settlement of the foundation stopped or reached an acceptable level? Is additional settlement likely or probable?
- Structural Damage - Has the settlement done, or is additional settlement likely to do, any significant damage to the structural members of the building?
- Functional Use - Has the differential settlement affected the property sufficiently that it is not suitable for its intended use?

TABLE V
TECHNICAL CONSIDERATIONS
IN REMEDIAL FOUNDATION DECISIONS

In some soils, screw type piles or helical anchors can be used. Segmented helical anchors are screwed into the ground until a known resistance is achieved. This resistance is used to determine the load capacity of the pile. Whether or not they are cost effective to use will depend upon the specific conditions at the site. In many instances, screw piles or anchors can be installed much easier and quicker than conventional underpinning devices, particularly if the foundation is not on pilings.

6.6 Recommendations If Remedial Work Is Undertaken:

The condition of the property should be documented before and after the foundation work is performed. As a minimum, the factors listed in Table VII should be given serious consideration before remedial work is undertaken. However, it should be remember that *the most common mistake made by homeowners undertaking remedial foundation work is the failure to consult an engineer before the work is undertaken. Even if an engineering inspection has been made, the proposed methods should be reviewed and approved by a Civil Engineer or Architect. In some parishes, this must be done to obtain a building permit.*

- The design and inspection criteria of HUD or any financial institution which might be used for financing the property should be determined. Supervision and inspection of the remedial foundation by an engineer may be required to obtain financing.
- The qualifications of the contractor should be determined.
- The design should be reviewed and approved by a registered Civil Engineer or Architect who has is knowledgeable in foundation repairs.
- Prior to the start of work, the extent of leveling, if any, should be discussed and understood as it is often not possible or desirable to completely level a foundation.
- Relative elevations should be taken before and upon completion of the work.
- The work should be inspected in progress by the Engineer or Architect.

TABLE VI
RECOMMENDED MINIMUM CONSIDERATIONS FOR REMEDIAL FOUNDATION WORK

7.0 LIMITATIONS

The inspection is performed and the report written for the exclusive use of the client. All others are cautioned that other information which may be significant in the evaluation of the property may have been provided separately from this report.

The report reflects Gilbert Engineering's professional opinion of the condition of the property at the time of the inspection based on a visual inspection of the readily accessible portions of the property. ***It is assumed that the building, including concealed components and systems, has been constructed and/or modified in accordance with the applicable building code at the time of construction. The inspection is not made for compliance with the present building code; however code violations may be mentioned in describing the condition of the property, particularly framing problems. No warranty is given or implied.***

Unless specifically noted:
1. No soil testing and analysis has been performed;
2. Concealed components and systems are assumed to be in satisfactory condition;
3. No engineering measurements have been made other than relative elevations; and
4. No stress or loads analysis have been made.

The client is cautioned that extensive and comprehensive engineering examinations such as the above items are required to fully evaluate the structural condition of the property. As a result, the possibility exists that some unforeseen or concealed conditions may exist or occur, such as changes in subsurface conditions or hidden structural defects, which could significantly effect assumed or future condition of the building. For this reason, it is a good practice for existing conditions, such as cracks, to be monitored on a regular basis over an extended period of time.

Space and time does not permit a comprehensive discussion of all conditions which might exist. If any additional information is desired, the engineer is available for discussion with the interested party. However, the discussions will be limited to an explanation of technical considerations. Extensive discussions and more in depth examinations and analysis may require additional fees.

Any sketches and layouts in this report are included to facilitate understanding of the results of the inspection. While they are generally correct and are based on field measurements, they may vary from actual conditions, particularly as to door locations and room sizes.

8.0 INSPECTION PROCESS

8.1 Reinforced Concrete Slabs:

The visible portion of reinforced concrete slabs are inspected for significant structural defects and cracks. The visible portion normally consists of the side of the slab and other exposed surfaces. Visibility of all or a portion the exterior surface is often blocked by such items as shrubs and flower beds. Relative elevations are usually taken to determine the extent to which the slab is out of level.

8.2 Pier and Beam Foundations:

The visible portion of the foundation is inspected for signs of structural defects and signs of settlement. This includes the inspection of piers, chainwalls, columns, sills, joists and subflooring, if readily accessible. Unless special arrangements are made, the inspection is normally performed from the exterior of the building unless there is a crawl space in excess of 36" between the ground and the lowest portion of the floor system. Inspections are often limited or blocked by shrubs, flower beds, and excess moisture under the building. In addition, many home owners install access covers or plastic (visqueen) over openings in chainwalls and between exterior piers. These are not removed unless they can be easily removed by hand and not damaged in the process. Relative elevations, as described previously, are taken to determine the extent to which the foundation is out of level.

8.3 Pilings:

Unless the pilings are readily visible, no determination is made as to whether or not the foundation is on pilings. If information on pilings is available, or if predominate construction practices in the area indicate that the foundation may or may not be on pilings, this information is included in the report.

8.4 Exterior:

Exterior walls are inspected from ground level for significant signs of structural defects and cracking. Access to exterior walls are often limited by flower beds, shrubs, stored materials and other exterior materials. Roofs are inspected visually from the ground unless previous arrangements have been made. The roof is inspected solely for indications of structural defects. No inspection for water tightness is made or should be implied unless specifically stated in the report.

8.5 Interior:

Interior walls, ceilings and floors are inspected for significant signs of structural defects, cracking or indications of concealed structural defects. Access is often limited by furniture and stored materials.

8.6 Attics:

The attics are inspected for signs of water damage to structural members, installation of normal bracing, and tightness of framing joints. Inspections are limited by head space (3' minimum required), stored materials, and difficulty in entering the attic. The attic should be readily accessible by folding stairs, access doors or panels without removing such items as stored material, closet shelves, etc. Access panels should be accessible from the next to top step of a six foot step ladder. The purpose of the inspection is to identify significant structural defects or problems, as a result, minor damage to framing and or roof decking may not be mentioned in the report.

8.7 Garages and Other Improvements:

Garages, carports, storage buildings, swimming pools, patios, sidewalks and porches as well as other non living areas are inspected as a courtesy to the client and are not considered to be a portion of the inspection unless they effect the structural integrity of the main building or contribute to foundation and/or settlement problems. To the extent practical and to which time allows, they are visually inspected and the information provided in the report.

8.8 Termite Damage:

Louisiana laws require that inspections for wood destroying insects be made by individuals licensed by the state and an inspection for termites or other wood destroying insects is not a part of this inspection. The building is inspected for significant damage to structural components by wood destroying insects and/or water. The inspection is limited to readily accessible areas. Finished materials are not removed unless special arrangements have been made. Concealed damage may cause signs of distress in the finished materials but this is not always the case, particularly if the building has been refinished or renovated. Concealed damage can only be confirmed by exposing the concealed structural members.

If live termites or termite tunnels are observed, they are generally mentioned in the report and a termite inspection is recommended. If termites and/or termite damage is observed during the termite inspection, the financial institution will normally ask for these area to be inspected to verify that there is no structural damage. Since the termite inspection will identify even minor damage, there is a reasonable possibility that termite damage will be identified during the termite inspection that was not observed and/or mentioned in the structural engineering report. Furthermore, since termite inspections are normally required to be completed within 30 days of "Act of Sale", it is not unusual for the request for verification of no structural damage at all points mentioned in the termite certificate to come during the last few days before the "Act of Sale". For this reason, the termite inspection report should be reviewed by the client as soon as possible.

8.9 Age:

Unless specific information is provide by the client prior to the inspection, the age of the property included in the report is an estimate based on the appearance and location of the property. It is used for statistical analysis purposes only.

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APPENDIX
THE EFFECT OF VIBRATIONS ON RESIDENTIAL BUILDINGS

INTRODUCTION

Residential buildings can be damaged by vibrations through four mechanisms:

1. Movement of the building due to air blasts or ground movement.
2. Settlement of foundations.
3. Impact of projectiles.
4. Permanent ground distortion produced by the vibrations.

This paper deals with the first two mechanisms since project impact and permanent ground distortion are not common in the New Orleans area.

When a building or the soil below the building are subjected to vibrations, the response of the building is determined by the characteristics of the building, environmental conditions including soil conditions and the characteristics of the vibration. The interaction of these factors is very complex and is a specialized field of study. For this reason, the text only touches on the basic fundamentals associated with the vibration of soils and buildings. Since some understanding of vibrations is required to understand the mechanisms causing the damage to the building, a cursory review of simple vibrations is presented at the start of the text.

SIMPLE VIBRATION

The following is a brief summary of definitions and characteristics of simple vibration theory which is the basis for most vibration analyses.

- Vibration - Vibration is a motion that repeats at regular intervals of time.
- Period - The period (of vibration) is the time required to complete one cycle.
- Frequency - The frequency is the number of cycles in a given period of time, usually cycles per second, referred to as Hertz (Hz).
- Amplitude - The amplitude is the maximum displacement of the vibrating body from the midpoint or stationary point.
- Damping - Damping in structures, due to friction and other causes, resists motion imposed by dynamic loads.
- Resonance - Resonance is the condition of a vibrating system under a given load such that the amplitude of successive vibrations increases. Unless limited by damping or other changes, the amplitude at resonance become very large, in some instances sufficient to damage or destroy the structure.
- Natural Frequency - The natural frequency is the frequency at which resonance occurs. If a structure is pulled out of position and released, the structure will vibrate at a given frequency, disregarding any effect of damping. This is the natural frequency of the structure. At the natural frequency, only very small forces or movements are required to significantly increase the amplitude of vibration. For example, when pushing a swing, only a very small force is required to increase the

amplitude if the push is applied at the same frequency as the natural frequency of the swing and person in the swing. Another example is the suspension of a coffee cup by several rubber bands jointed together. If the hand holding the end of the rubber bands is moved up and down very rapidly, there is little movement of the cup. If the movement is slowed, eventually the cup will begin to have much larger movements as the rate of movement of the hand approaches the natural frequency of the system. The natural frequency of a structure is dependent upon its weight.

GROUND MOTION

Introduction:

Construction activities transmit energy in to the ground which causes the ground to move or vibrate. The energy is transmitted in the form of repetitive motions, such as the vibration associated with driving sheet piles with a vibration device or impulses such as produced by concrete breakers, pile driving or blasting. Combinations of these motions are common.

Peak Particle Velocity:

Peak particle velocity (PPV) is used in the description of construction vibrations. The PPV is the maximum velocity of the vibration. Mathematically, the PPV velocity is the vector sum of three velocity vectors, shown in the adjacent Figure 1. Where a velocity vector is the geometric representation of velocity shown relative to a two or three axis reference. The vector sum is the mathematical sum of the X, Y, and Z vectors.

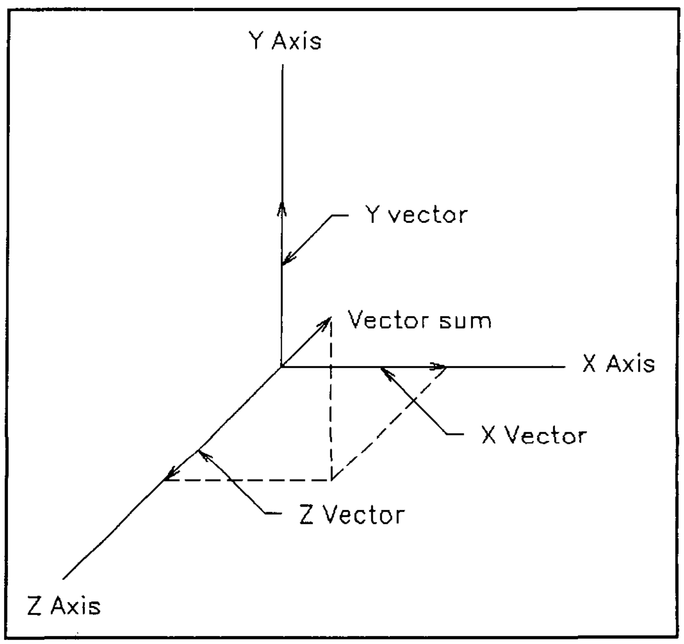

Figure 1 - Three Dimensional Vector System

Time Histories:

Field measurements of the PPV are made with an accelerometer which measures the particle velocity in three perpendicular directions. The peak particle velocity is then calculated using these three vectors. In some instances, the term pseudo-peak particle velocity is sometimes used to distinguish between measured particle velocity from calculated particle velocities. Figure 2 shows typical time history of a vibration which might be measured in the field energy impulse from pile driving or similar impact ground movement. Peak particle velocities are usually expressed in inches per second.

Predominant Frequency:

Since ground motion is often irregular, the predominant frequency is determined by measuring the time between peaks and valleys. Predominant frequencies for construction vibrations range from 4 Hz to 120 Hz.[1]

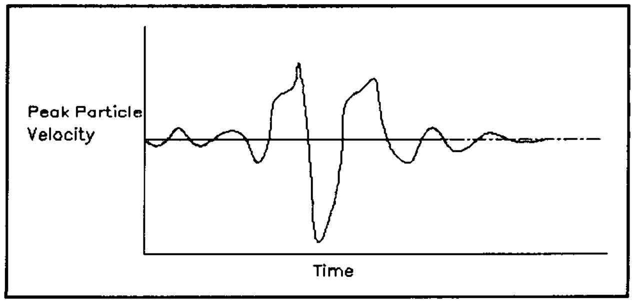

Figure 2 - Typical Pile Driving Impulse

Wave Motion:

The energy moves through the ground in the form of a wave. Body wave propagates through the body of the soil. Surface waves are transmitted along the surface of the soil.

Attenuation:

As the wave moves away from the exciting force, the PPV decreases or attenuates. The rate of attenuation is dependent upon the type of wave, soil characteristics and the distance from the source of vibration. For a given vibration source, peak particle velocities measured in stiff clays may be as much as 5 to 7 times the peak particle velocities measured in loose sand.

EFFECT OF GROUND MOTION ON BUILDINGS

Introduction:

The vibrations cause ground motion below the building, similar to the pushing of the swing or the movement of the hand above the object suspended from the rubber band. The response or movement of the building is determined by the PPV of the ground, the predominant frequency of the vibration and the natural frequency of the building. The movement of the building causes stresses and strains in the building which can cause both cosmetic and structural damage. The movement of the ground can also cause consolidation of subsurface soils, particularly layers of loose sand or silt.

Damage Threshold:

During the past twenty to thirty years a considerable amount of investigations have been made by engineers to determine the effect of vibrations on residential and commercial buildings. A significant portion of the studies, particularly the early studies were done on the effect of vibrations and shock waves due to blasting surface mining.

These studies attempted to establish a damaged threshold (i.e. a safe value below which damage either is unlikely or will not occur). As a result of studies on a large number of residential properties, the United States Bureau of Mines issued a report which indicated that damage was unlikely to occur if the Peak Particle Velocity (PPV) is below 2.0 in/sec. This value was substantiated to some degree by independent studies in Sweden and Canada. Later, the Bureau of Mines issued Report RI 8507 which revised the guide lines down to 0.75 in/sec for modern homes with drywall interiors and 0.50 in/sec for older homes with plaster on wood lath but specifically pointed out that cracking could occur a lower levels in the sheetrock was already stressed from other environmental causes..

For a considerable period of time, studies both in the United States and other countries have shown that damage to a building is dependent upon a large number of factors including the type of construction, the age and condition of the building, the predominant frequency of vibration, number of vibrations or the period of time the building is subjected to the vibrations, soil conditions and the natural frequency of the building. However, the use of a single parameter to indicate damage potential of a ground vibration is widely used despite the fundamental problems associated with that approach. Furthermore, the values, 2.0 in/sec, 0.75 in/sec and 0.50 in/sec have become ingrained in a large portion of the literature on the subject.

Threshold Envelopes:

As early as 1970[2] threshold envelopes which correlated PPV, the frequency of vibration and other factors were being proposed. These envelopes show the area in which damage is most likely to occur. The ranges have predominant frequencies starting around 2Hz. The upper frequency varies, but is generally limited to approximately 20 Hz for buildings. Peak particle velocities range from as low as 0.2 inch per second to 9 inches per second.

Natural Frequencies of Buildings:

Calculation of the natural frequency of a building is very difficult due to the complexity of the building. Simplified methods of calculations have been developed for use in building codes and other purposes. These methods are generally based on the height of the building and the ability of the building to resist lateral forces. The natural frequency of residences is generally accepted to be in the range from 4 Hz to 10 Hz. In addition to the natural frequency of the building, individual components, such as walls and ceilings have their own natural frequency, ranging from 12 Hz to 20 Hz. Field studies show that the building and interior components continue to vibrate freely after the ground vibration passes, if the frequency of vibration is at or near the natural frequency of the building or components of the building.

Construction Vibrations:

Construction vibrations tend to have predominant frequencies in the range of 4 Hz to 120 Hz. As a result, most construction vibrations are not likely to cause damage to residential building. However, the lower range, 4 Hz to 20 Hz can cause both structural and cosmetic damage.

Types of Damage:

Most damage to buildings from construction vibrations is cosmetic in nature, although structural damage does occur. The most common type of damage is cracking of finish materials. Cracking of finish materials occurs naturally due to the stresses and strains associated with weather conditions, differential settlement and other causes. Due to stresses and strains occurring naturally in buildings, finish materials may already have hairline cracks or be on the verge of cracking when subjected to construction vibrations. In these cases, cracking may occur at low PPV values if the predominant frequency of the construction vibrations is near the natural frequency of the building or its components.

Susceptibility of Buildings:

Buildings which may be subjected to construction vibrations should be classified as to the building's susceptibility to damage. Usually these classifications are based on the susceptibility to cracking since cosmetic damage is more likely than structural damage.

Highly susceptible buildings are those which already have experienced a significant amount of degradation to the primary structural or nonstructural components or systems. This includes buildings with:

Loose or unstable elements such as bricks or hard shingles;
Cracked stucco or plaster;
Considerable differential settlement;
Subsurface soil conditions which may be effected by the vibrations.

Moderately susceptible buildings are those which have not experienced significant degradation of the primary structural and nonstructural components or systems, but which has experienced some deterioration or are more fragile than normal or which have potentially unstable conditions.

Low susceptible buildings are those which are unlikely to experience cosmetic damage when subjected to vibrations.

Fatigue:

Failure and cracking of structural and nonstructural components occur at lower stress levels when subjected to repeated loading. Studies have shown that damage from vibrations occur at PPV levels as low or lower than 0.05 inches per second after 52,000 cycles.

AIR-BLAST AND CONSTRUCTION NOISE VIBRATIONS

Introduction:

Air-blasts and construction noise are the common description of air pressure waves generated by explosive detonation or construction equipment. The pressure waves have a wide range of frequencies, many of which are not audible. For the most part, only the lower frequencies effect buildings.

The pressure waves can be recorded in the same general manner as the ground vibrations. The magnitude of the pressure is either recorded as an overpressure in pounds per square inch or decibels. Over pressure indicates that the reading is the pressure above atmospheric pressure. Decibels are a scale used by acoustical engineers which compresses overpressures into much smaller range.

Thresholds

Air-blasts, particularly those associated with blasting and sonic booms can cause damage to buildings, primarily cracking of finish materials and in some instances glass. Extensive work has been done to determine the threshold where damage occurs. Most threshold cracking occurs at sound pressure levels higher than those normally anticipated from construction equipment. However, unusual conditions can exist which could cause cosmetic cracking of finish materials. Structural damage is unlikely to occur.

Conditions which could result in cracking of finish materials includes but is not necessarily limited to:

1. Materials stressed to near cracking due to other conditions such as differential settlement or thermal stresses.
2. Unusually high noise levels from construction equipment.
3. Environmental conditions which can focus or magnify the intensity of the pressure.
4. Frequencies that cause resonance in walls, ceilings or other components.

VIBRATORY SETTLEMENT

Vibrations have long been recognized as an effective means of consolidation of cohesionless materials such as surface layers of looses sands and silts. These types of soil conditions exist throughout the Greater New Orleans area. The vibrations can not only cause consolidation of the soils, but in some instances, liquefaction of the soils. In either instance, minor to significant settlement can occur. The amount of consolidation which may occur, increases when the water table is close to the surface as in generally the case in the New Orleans area. The primary source for vibrations which can cause vibratory settlement is pile driving; however, vibrations from bus and truck traffic can also be a source.

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- Drop hammer type pile drivers have input energies in the range of 20,000 to 140,000 ft pounds. As the piles are driven, energy is transferred from the pile into the soil in the form of a shock or vibration wave, see the Appendix. The energy causes ground movement or vibrations that propagate through the soil until the energy is dissipated.

The Peak Particle Velocity[1] (PPV) is commonly used to describe the movement of the soil (see Vibration Appendix.) Time histories of pile driving are made on construction sites using accelerometers. Figure 1 shows a typical time history of the an energy impulse from pile driving using the PPV. The most important parameters that describe the time history of the vibration are peak amplitude
(PPV), the principal period or frequency, and the duration of the vibration.

The distance over which the vibration is dissipated is determined by the soil characteristics. Vibrations are transmitted over a greater distance in stiff clays such found in this area as opposed to softer clay found in other sections of Metairie. The difference in stiffness between a loose and stiff subgrade is associated with a 5 to 7 fold increase in PPV. Table I summaries peak particle velocities measured at varying distances as a result of a drop hammer driving piles through loose deposits.

Peak Particle Velocity Large Drop Hammer Pile Driver	
Distance	PPV
11 Feet	2.0 In/sec
25 Feet	1.0 In/sec
30 Feet	0.4 In/sec
60 Feet	.03 In/sec

While PPV values of 0.5 in/sect to 2.0 in/sect have been used to
However, in some instances the construction vibrations can cause consolidation of subsurface straits, particularly layer of loose sand or silt. There is a possibility that some settlement may still occur, but this is not considered to be a high risk.

[1]. The term "peak pseudo particle velocity" is sometimes used to distinguish between measured and calculated velocities.

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